

A COMPLETE LIST OF

The Photo-Miniature Series

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Subject D.—Figures, extra-dark and near to camera. Twice the exposure of standard “strong foreground” subject, C

The figures in this group, reading from left to right, are Alfred Watkins, of exposure meter fame; S. H. Fry, and the late A. Horsley Hinton. Photograph by George E. Brown at the Hereford (1907) British Photographic Convention.

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Correct Exposure How to Calculate It

Correct exposure — the ideal of all photography and photographers — is the key to success, not in negative-making only, but in all branches of photographic work. The act of removing the lens cap, or pressing the pneumatic bulb of the shutter, seems one of such utter simplicity that to devote a full number of THE PHOTO-MINIATURE to its discussion may seem at first to be wholly unnecessary. But, simple as the operation appears, the factors which underlie exposure are fairly numerous, and have grown in number since the introduction of orthochromatic methods in photography, of diverse shutters and lenses, and of attempts on the part of photographers to deal with subjects which a few years ago would have been considered outside the scope of the camera. Therefore, in writing an essentially practical guide to the correct exposure of the photographic plate or film, the writer must keep in mind more than merely the old academic factors, viz: The aperture of the lens; the sensitiveness of the plate; the strength or intensity of the light; and the character of the subject photographed.

These, naturally, still form the staple features in discussing exposure, but there must also be borne in mind the ability of different types of shutters to give the exposure which has been found necessary; the ability of the plate to "make good" with less time when the rapidity

of movement in the subject compels a very short exposure; as well as the limits, as regards hand-camera photography, which are set by the use of a screened ortho plate. Something must be said, too, as to exposure conditions in photographing scenes by moonlight, or under artificial outdoor lighting, as well as of the precautions which must be observed in exposing from moving vehicles, railway trains, steamboats, and electric cars or omnibuses. So comprehensive is our program that prudence forbids further delay in commencing it.

Three Ways of Finding Exposure

I suppose I can give my reader the credit of knowing that it is the lens which determines the form of the scene or object in a photograph. Exposure determines the correct rendering of the light and shade: It has nothing to do with the form of the object, unless the latter is moving, in which case the exposure must be so short that the amount of movement of the image on the plate is imperceptible. This exposure may not be enough for the proper rendering of the light and shade, but, for the present, we will leave this out of consideration, and confine ourselves to the full exposure of the plate, with the object of producing a negative as perfect as possible as regards rendering of the light and shade in the scene photographed. Really, it is out of place to speak of a "correct" exposure, for most exposures are compromises; and one part of the plate will get too little, while another gets too much.

There are three ways of arriving at, let us say, the "best" exposure:—by instinct, by an "exposure meter," and by an "exposure calculator." The first is undoubtedly the possession of many photographers, who by long practice can "size up" the exposure required, without separately estimating the strength of the light, the speed of the plate or the character of the subject. Obviously, it is useless to waste words over this method, because it is not one which can be taught. With an exposure meter (i.e., an actinometer) we do actually measure the most elusive factor in the case, namely, the strength of the light. Instruments which allow of this being done are the real "exposure meters," as distinguished from the "exposure-calculators" (Method No.

3), which deal with the light question in another way. In a calculator we get figures telling us the actinic power of the unclouded sun at different times of the day and year, and have to judge for ourselves to what extent that light is dulled by clouds or prevented from reaching the subject by foliage, tall buildings, etc.

Advantage of the Meter So far as allowance for the aperture of the lens and the speed of the plate, the two methods are similar, but the exposure-meter has several great advantages over the tables or calculators. First, it measures the *chemical* action of the light, not the visual effect, which is often different, and then, in any case, the eye is a notoriously bad judge of the different degrees of illumination. It can tell when things are equally illuminated, but it makes big mistakes in judging how different the illumination is in various cases. To quote Professor Silvanus Thompson's concise phrase, "the eye can equate but cannot appraise." It is the meter which does the appraising, and thus renders this method of ascertaining the correct exposure a far more accurate one in interiors, under trees at evening, and in all circumstances where the subject allows of the actual light falling upon it being measured.

A further disadvantage of the calculator, compared with the meter, is that the tables of the former hold true only for a given meridian of the world's latitude. A calculator which is correct for Norway, in latitude 60° , becomes appreciably "out," morning and evening, in Germany or the southern provinces of Canada. The explanation and extent of this disability are the subject of a later paragraph, but it amounts to this, that the worker who familiarizes himself with an exposure-meter can take it with him everywhere and rely upon its guidance, be the place, time or weather what it will.

Before dealing with the practical use of these two methods, we must consider the several effects of two factors which are of equal importance in both systems.

Factor No. 1 Of the four chief factors concerned in exposure, namely, lens-aperture, plate, light and subject, the first is the only one which admits of really exact calculation. We can-

not estimate or measure the others nearly so exactly. As the reader no doubt knows, a lens aperture is denoted by the f number, that is, the number of times which the diameter of the aperture divides into the focal length of the lens. Thus, a lens of sixteen-inches focal length and two-inch diaphragm is said to have rapidity of $f/8$, or "to work" at $f/8$. The first general rule in exposure is that *the time required varies as the square of the f number*.

Thus, with an f number twice another, one must give four times the exposure; with one three times another, one must give nine times the exposure. That rule applies in all cases, but it is important to distinguish between the f numbers and U. S. diaphragm numbers, because the latter are specially designed to avoid the use of "squared" numbers. Though they get over the difficulty so far as different stops are concerned, we still have to work on the basis of "squares" when the lens is used at an extra focal extension. (See paragraph "Focal Extension and Exposure" below.)

The basis of the U. S. stop is an aperture one fourth the diameter of the focal length, that is $f/4$. This is No. 1 on the "Uniform System." No. 2 is a stop of double the *area*, corresponding therefore with double the exposure, and equaling $f/5.6$. Similarly, No. 4 U. S. is again double the area of No. 2, or double the diameter of No. 1. It is therefore $f/8$. The advantage of the "Uniform System" is that the numbers represent the relative exposures. The method was abandoned in England a few years ago, and is now used only on Kodak and other cameras made in the United States.

The following table gives the f numbers equivalent to standard U. S. apertures:

U. S.	1	$1\frac{1}{4}$	2	3	4	8	16	32	64	128	256
F.No.	$f/4$	$f/4.5$	$f/5.6$	$f/7$	$f/8$	$f/11$	$f/16$	$f/22$	$f/32$	$f/45$	$f/64$

With the exception of $f/4.5$, which is inserted here on account of the frequency with which it is now used, each stop in this series calls for twice the exposure with that preceding it.



FIG. 1

Subject A.—Distant (open) landscape. One-quarter exposure of standard "strong foreground" subject, C



FIG. 2

Subject B.—Light-foreground landscape. One-half exposure of standard "strong foreground" subject, C



FIG. 3

Standard subject C.—Landscape with strong foreground



FIG. 4

Standard subject C.—Building or street scene with strong foreground

**Diaphragms
and
Exposures**

We have seen that the f number is the result of dividing the focal length by the diameter of the aperture. Consequently, if (when using the same lens) either of these quantities is altered, the necessary allowance must be made in the exposure. The reader sees at once that the diameter of his stop varies by opening and closing the lens, but he may wonder how the focal length of a lens can vary. Let us take the latter in a moment. First as regards the stop. It is a geometrical fact that the area of a circle, or disc, varies not in proportion to its diameter, but in proportion to the *square* of its diameter. That is, our diaphragms admit light in proportion to the square of their diameters; but as, in obtaining the f numbers we divide the focal length by the diameter only, and not by the *square* thereof, we must take the squares of the f numbers as the basis of comparative exposures. As lenses are fitted with diaphragms from $f/4$ to $f/64$, this factor alone amounts to a variation of exposure of from 4×4 or 64×64 —from 1 to 256. In other words, if a subject requires one second exposure at $f/8$, other things remaining the same, it will want one-fourth second at $f/4$ and sixty-four seconds at $f/64$.

**Focal Ex-
tension and
Exposure**

Now the other factor in the f number, the focal length, may also vary—we are speaking of one and the same lens. When photographing most subjects fairly distant from the camera, the focal extension (i. e., the distance of the lens from the plate) remains the same. This distance is (near enough) the focal length of the lens, and therefore the $f/$ number marked on the lens-mount, or on the shutter, is the true working aperture of the lens. But when we want to photograph a very near object, we find we have to rack out the lens further, and the f number on the lens corresponding with each stop at once ceases to denote the true working aperture. To get the latter, we must divide the actual focal extension by the diameter of each diaphragm. This gives a larger f number, and exposure must be given on this basis, that is, in proportion to the squares of the f numbers—for our rule holds good here, as always.

We can neglect the effect of this extra extension until we get so near to an object that the image is as big as one-tenth the height of the object. From this point onward, increased exposure becomes necessary, and allowance must be made for it in copying, and in enlarging direct in the camera. As in this work it is usual to keep the same stop in the lens, it is more convenient to allow for the exposure by the focal extension only, the time being proportional to the square of the extension.

Thus, in photographing a large painting from some distance, the lens will be at its normal extension (the focal length) of, say, six inches. When photographing part of the painting, half scale, the focal extension will be nine inches, and the exposure must be increased in the proportion of $6 \times 6 : 9 \times 9$, that is as 36 to 81, or two-and-one-fourth times. Two useful tables for rapidly applying this rule are given on a later page.

So far as concerns exposure, it does not matter how the greater focal length is produced, with the same set of diaphragms, the exposures will go as indicated by the actual working *f*/number. This is a point which must be kept in view when using the single components of a doublet lens. In most lenses, the diaphragm markings become quite wrong when the front or the back lens is used alone. Usually, each component is double the focal length of the complete lens, so that each diaphragm number requires to be doubled, i. e., four times the exposure given. Some lenses are made with one component double, and the other one-and-one-half times the focal length. In the case of the latter, exposures will be $1\frac{1}{2} \times 1\frac{1}{2}$ times (twice) those for each stop when using the complete lens. The user of a lens of this unsymmetrical type will find it best to carry a card giving the values of the stops for the whole lens and each separate component. Thus, for a lens of five inches focal length, having single components of ten and seven-and-one-half inches, the values of the stops will be as follows:—

Complete lens . .	<i>f</i> /5.6	<i>f</i> /8	<i>f</i> /11	<i>f</i> /16	<i>f</i> /22	<i>f</i> /32	<i>f</i> /45
Ten-inch focus . .	<i>f</i> /11	<i>f</i> /16	<i>f</i> /22	<i>f</i> /32	<i>f</i> /45	<i>f</i> /64	<i>f</i> /90
Seven - and - one - half-inch focus .	<i>f</i> /8	<i>f</i> /11	<i>f</i> /16	<i>f</i> /22	<i>f</i> /32	<i>f</i> /45	<i>f</i> /64

Slow and Rapid Lenses A good deal of mystification is created by the statements of lens-makers that certain lenses are "extremely rapid." Beginners, I know, wonder whether one lens at, say, $f/6$, is more speedy than another at the same aperture. Actually (in practice) there is no difference. Practically any lens, unless its glasses have become colored with age or have suffered great loss of polish, is as rapid as any other of the same f number. Any difference which may exist is due to the greater or less number of glasses (and therefore of reflecting surfaces) in the lens, or to the greater thickness of glass. But when all is said and done, these variations in construction will not account for a difference of more than 20 per cent in the rapidity of the lens at the outside; in other words, six seconds exposure instead of five. The reader will be safe in taking aperture, and aperture only, as the measure of the rapidity of a lens. We should call a lens of $f/4.5$ one of "extreme rapidity," as large an aperture as it is useful to have; one of $f/5.6$ or $f/6$, a "rapid" lens (the most useful aperture for all-round work), and lenses of $f/8$ and under as "slow," and suitable chiefly for time-exposure work, not for hand-camera or instantaneous photography except under favorable conditions.

Factor No. 2 As regards the second chief factor in exposure, we are much in the same position whichever method we use: "exposure-meter" or "exposure-calculator." The makers of the Watkins and Wynne meters issue tables of plate-speeds at frequent intervals: with "calculators" also, such as the very convenient pattern contained in the "Wellcome Exposure Record," a list of plate-speed numbers is given. In both instances, one requires to make sure that the sensitiveness of the plates to be used does actually answer to a given number on the tables. This is particularly necessary when using plates of extreme rapidity, because it is these which most tax the skill of the plate-maker to keep to standard. Slow and medium-speed plates are much less liable to show discrepancies between the actual speed and that given by the makers of meters and calculators. It is not uncommon to find that the plate-makers' statements as to speed

vary considerably on this same point. One will mark a plate twice as fast as another which is found both in practice and by the meter-makers to be its equal.

**Checking
Speed
Numbers**

Therefore, whichever method is being employed, a point should be made of making for oneself a check in the speed-number. Select a subject which corresponds with the "strong foreground" (Figs. 3, 4 or 5) taken as a standard in almost every system of exposure and, having ascertained the exposure required for the speed given in the tables, give one or two exposures on this basis, one or two taking the speed as double, and one or two with speed as half. Develop all together in the developer which you customarily use, and compare results. In making your tests in this way, be sure that the exposures *are* actually the double and half of the standard. It won't do to rely on the markings of most instantaneous shutters for this purpose: better to keep the shutter at the one speed and give the half exposure by using the next smaller stop and the double by the next larger; or, if the exposures ran into a decent number of seconds, say, not less than five, exposing by cap or "time" adjustment. To obtain a really useful test, the scene should be brightly lighted with some cast shadows and a good range of contrast. A few plates exposed in this way before starting a tour would save much later disappointment. It gives the user of a meter the plate-speed number which he personally should use to compensate, not only for any difference between the meter-makers' figure and the plate-makers' actual performance, but also for any tendency on the part of the user to read the tint of the meter-paper too dark or too light. Plate-speed number is the best factor to choose as a species of regulator by which to adjust a meter or calculator to one's own peculiarities — the "personal equation," as the scientific folk have it.

**Plate Speed
Numbers**

In this country photographic manufacturers do not, as a rule, mark their plates with a speed number; they use the terms "Rapid," "Fast," etc., or various fancy names, to indicate degrees of sensitiveness. Many British makers mark by the H & D (Hurter & Driffield) system, though not



FIG. 5

Standard subject C.—Figures at fair distance from camera



FIG. 6

Subject D.—Landscape with extra-dark foreground. Twice the exposure of standard “strong foreground” subject, C



FIG. 7

Subject D.—Building or street scene with extra-dark foreground. Twice the exposure of standard “strong foreground” subject, C



FIG. 8

Subject D.—Figures, extra-dark and near camera. Twice the exposure of standard “strong foreground” subject, C

strictly on the lines laid down by the authors; so that H & D numbers on the boxes of different makers, and not always on those of the same maker, are not comparable. Some few makers mark also the Watkins speed, and one or two also the Wynne; but, as the reader will have gathered from the previous paragraph, whatever figure is taken as the plate speed, it is well to confirm it by one or two practical exposures under test conditions. As a rough guide to speeds, we may give some figures which are not far out in giving an idea of the speeds of the ultra-rapid,* extra-rapid, medium, and slow plates, made by most leading makers.

	Watkins	Wynne	Wellcome	Proportional Exposures
1. Ultra-rapid	250	$f/111$	$\frac{1}{8}$	1
2. Extra-rapid	180	$f/90$	$\frac{1}{6}$	$1\frac{1}{2}$
3. Medium	90	$f/64$	$\frac{1}{3}$	3
4. Slow (or landscape) . . .	45	$f/45$	$\frac{2}{3}$	6

These are round average figures, yet the user may take them as approximations, to be checked by one or two exposures timed by a meter. As it is not usual to use plates slower than No. 4 in our table, it will be seen that, the other conditions remaining the same, exposure according to one's choice of plate ranges from 1 to 6. The opportunity for error when using a plate marked as of the highest, second, third and fourth degree of rapidity by the maker, is of course very much less; for plates of a given alleged speed are not likely to differ from each other more than about 100 per cent.

So far, everything we have said applies with equal force to both meters and calculators, but of the two other factors in affecting exposure,—the light and the subject,—the first is treated quite differently in the two systems, and the second differently in certain cases, so that, to avoid confusion, we must consider them separately. We thus come to this essentially practical part of our subject, the use of an exposure-meter.

The basis of the system, as carried out in both the Watkins and Wynne meters, is actually to measure the chemical or actinic power of the light, immediately

*Mr. Watkins in his latest speed-list give a higher speed than 250 in the case of seven plates only.

before exposure, by means of a piece of prepared paper having the property of darkening in the light much more quickly than ordinary collodion or other print-out paper. This sensitive paper is placed so that a small portion of it comes against a patch of bluish paper of "standard" tint. The time required for the paper to reach this standard tint is the measure of the actinic power of the light. It is the 'actinometer-time' of the meter. Obviously, it is necessary that we measure the light which falls on the *subject*. The light which falls on the *camera* does not matter. We can put the camera at the back of a veritable black hole of Calcutta, and, so long as the rays reflected from the subject reach the lens, the exposure will be all right. This essential in the use of an exposure-meter cuts both ways. It is easy enough to place the meter in the shadow of a near building when photographing subjects close at hand (the shadow of one's body is a quite satisfactory substitute for that of the actual subject): it is easy to test the actual working light when photographing in woods, under trees or in interiors; but when our subjects are a long way off, when they are open landscapes, or when they are of a specially "light" character (that is free from masses of shadow), it becomes necessary to use our own judgment, and to make allowance for the greater or less amount of light which is *reflected* by the subject to the lens. In this we are aided by certain factors which have been found to hold good in regard to these departures from what we may call the "standard" subject. We will define and illustrate these classes of subjects directly. Meanwhile, let us see how the exposure-meter is used in practice, bearing in mind the fact that its indications hold good so long as the light falling on the meter fairly represents the light falling on the subject, but that the indicated exposures need to be increased or decreased when this is not the case, or when the subject is specially light or dark in color.

The two meters most commonly in use are the Watkins and the Wynne. Both are employed very similarly, although the construction differs somewhat. In the Watkins most popular form of dial meter known as the

"Bee," which is everywhere available, the outer metal rim of the dial has engraved upon it a scale of plate-speeds up to 500 (equivalent to as rapid an emulsion as



is made); and a scale of exposures from 130 seconds (or minutes) to three-fourths, and thence downward as '2, '3, '4, and so on, these numbers (prefixed by an apostrophe) denoting, $\frac{1}{2}$ -, $\frac{1}{3}$ -, $\frac{1}{4}$ -second, and so on. This scale of fractional exposures is continued on, so that the same series of numbers does duty also as plate-speed numbers. On the inner and revolving part of the meter is a scale of actinometer times from

130 to 6 seconds (or minutes), and a scale of diaphragms from $f/4$ to $f/90$. Discs of the sensitive paper are held behind this dial, and a fresh portion is brought into position for exposure by turning the back disc of the meter a little. A fresh piece of sensitive paper is brought between two patches of standard tint, one a quarter the depth of the other. The deeper is that which is usually used out-of-doors, and the times obtained with it are



those to be used in setting the meter. But, in very dull evening light and in interiors, the use of the full tint may need too long a time, and then it is convenient to expose the paper by the quarter-tint and multiply the time noted by 4.

In the Wynne Meter

meter, similar full and quarter-tints are provided, but the arrangement of grad-

uated scales is different. Really, there are but two scales, but each serves two purposes. The outer fixed scale is one bearing diaphragm numbers from $f/4$ to

$f/256$, the plate speeds being worked out in such a form that this same scale can be used for them. The inner movable scale bears numbers from 64 seconds (or minutes) to one one hundred and twenty-eighth of a second, and serves both for actinometer times and exposures.

**Their
Differences**

In practice, the difference in construction amounts to this: With the Watkins Bee meter, we first set the aperture of the lens opposite the speed of plate we are using. Then, opposite any time which the paper may take to darken to full tint, we see the exposure necessary.

With the Wynne, we set the time required by paper to darken opposite the speed number of the plate in use, and then we see opposite every diaphragm the exposure necessary. Thus, if we are working with the same stop throughout the day, it will be quicker to work with the Watkins than with the Wynne: we shall set the stop number opposite the plate number, and shall not need to move the scale of the meter, but only to look what is the exposure corresponding to a given actinometer number. On the other hand, if we are anxious to use a larger or smaller stop, the Wynne tells us at once what exposure corresponds with each, and allows us to see at a glance whether it is advisable to expose longer with a smaller stop or shorter with a larger one. Very frequently—e. g., when there are moving objects in a picture—it is of the first importance to make exposure short: we shall use the larger stop. In other cases, the nearness of an object may necessitate a smaller stop in order to secure sharpness in all parts of the subject. The “Wynne,” at one setting, indicates the correct-exposure time corresponding with each diaphragm.

**The Standard
Subject**

The class of subject which is taken by makers of exposure=meters and tables as the “standard” is one in which prominent objects are fairly near to the camera. It is so taken chiefly because it is the most common. It includes landscapes with a fairly strong foreground, as distinguished from a landscape in which the masses of shadow nearest to the camera are in the middle distance. It includes street scenes, where buildings are not excep-

tionally dark. Figs. 3, 4 and 5 may be taken as typical examples of this "standard," or "strong foreground" subject, in landscape and architecture respectively. Compare it with the examples of the "light foreground" (Fig. 2) and "heavy foreground" (Figs. 6, 7 and 8), and you will see better what is meant by it.

Testing the Light

An old rule—and a good one—in photography is to "expose for the shadows." That means that in using a meter we must measure the light which reaches the shadow of the subject. In the case of our standard subject this will not be a very deep shadow, and it will be found perfectly satisfactory to hold the dial of the meter in the shadow of one's own body, but facing the source (the sun or the sky) from which the light comes. Hold the meter almost at arm's length and with your eyes half-closed. This makes it easier to judge when the paper just matches the tint in depth. It is depth alone which matters; the paper will not always match the tint in color. A fresh section of paper having been shifted into position between the two tints, commence counting seconds until the paper, which is light at the start, is seen to equal the tint. This time is the "actinometer" number of the light. In the shadow of the body in bright summer sunlight, it will be about five to ten seconds. The reader will be safe in taking it that, in the case of subjects such as Figs. 3, 4 and 5, the use of the shade of the body as a substitute for the shadow of the subject will not lead him astray. Yet many subjects present greater depths of shadows, and here the meter should be placed (again facing the source of light) where it will measure the light falling upon this poorly illuminated part of the subject. The avenue of trees in Fig. 6 is an example. To secure fair detail within the shadow of the trees, we cannot disregard the much feebler illumination there: the meter may be held there (not perhaps in the very darkest spot), and the light measured. If the difference proves to be very great compared with the light outside, it will usually be well to give an exposure somewhere between the two; since in an extreme case, such as this, exposure of both is bound to be a compromise. But the meter does actually

tell us where we are. Often, in a case like this, you will think that the meter is telling you to give too much time; but I venture to predict that after development you will agree that the meter was right and you were wrong. If the subject should be one without recesses of shadow whilst the light falls flatly upon it, the right thing to do in getting the actinometer number is to point the meter directly to the light, even sun. But it is rare to meet with such a subject, and such lighting usually gives an unpleasing, flat effect.

The Directions of Lighting This leads me to digress a moment, to point out that one great virtue of the meter is that it *makes* us pay attention to the direction in which the light falls on the subject. And this is of equal importance to correct exposure in giving a successful and pleasing result.

As a rule, the lighting most favorable to a good photograph is direct sunlight coming from behind the camera from a point about midway between back and side,—that is to say, from the north-east or the north-west point of the compass, supposing the lens is pointing directly south. The same rule holds good, though in lesser degree, if the sky is more or less clouded; but then the same brilliance of result cannot be expected. With an unclouded sky, the chief beauty of sunshine, that of the shadows, is lost if exposures are made around noon. The best time of the summer day is really before nine o'clock in the morning and after three o'clock in the afternoon. When the sun is higher in the heavens the cast shadows are both short and intense. Two kinds of lighting are especially to be avoided: namely, that in which the sun directly faces the camera, and that in which it is directly behind it. The former (Fig. 10 is an example) turns the shadow side of the subject to the camera and calls for a very greatly increased exposure. The second removes all relief and contrast from the subject, owing to the absence of cast shadows. It calls for much less exposure than the same subject under good lighting. These few simple rules will put the beginner in the way of avoiding failures. If he will make intelligent use of a meter, and follow the rule of turning the meter toward the source of light, it will be



FIG. 9

Subject B. — Landscape with light foreground. Half the exposure of standard "strong foreground" subject, C. With trees in full foliage this subject would fall in Class C or D.



FIG. 10

An example of exposure against the light. Owing to the shadow side of figures being turned toward the camera, a subject lighted in this way requires much more exposure (two or three times) that which would be sufficient were the light coming from behind the camera.

impossible for him not to consider the kind of lighting to which he is subjecting a subject.

**Sunshine
Effect**

The brightness of the lighting of a scene in which the sun is shining will often lead the worker to disregard the fact that a proper rendering of that sunshine effect calls for a good deal more exposure than is necessary when the lighting is more diffused. The bright sun brings to light much detail in the shadows, and to convey the effect of sunshine it is necessary to expose for these shadows. In practice, subjects on which the sun falls direct from one side or the other are difficult to over-expose. The result will then have the soft bright effect of sunshine, instead of the hard detailless shadows which represent the insufficient exposure of the ordinary snapshot.

**Interiors, Etc.
by Meter**

To return to our meter; the standard rule for using it is to expose the sensitive paper to the light which is actually reaching the deepest shadows which form an important part of the subject. That applies to shadows cast by buildings near at hand, to those under trees, in woods, inside buildings, large and small, and light and dark. In these latter, the time taken by the paper to come to the full tint may be so long that it is better to use the quarter tint, and then to use such a stop in the lens that the time which the paper takes to come to this quarter tint is the actual time of exposure,—that is, expose actinometer and plate at the same time. Mr. Watkins, in his "Exposure Notes," gives the values of these stops for plates of different speeds. One or two of these figures are as follows:

Plate speed . . .	250	180	130	90	65
Stop	$f/64$	$f/56$	$f/45$	$f/40$	$f/32$

That is to say, when using a plate of 180 speed, we shall set the lens at $f/56$, uncap it at the time of commencing the exposure of the meter paper, and cap again when the paper has matched the quarter tint. In very dark interiors, this will still mean a very long exposure, but there is still a further plan of using a sixteenth tint, which is the first perceptible darkening of the paper,

and is seen by turning the meter paper forward a little to bring the exposed against an unexposed piece. With the appropriate stop in the lens, exposure is done when the meter paper begins to show a difference from a bit of it which has not been exposed at all.

Distant Objects As to distant and very light objects, the indication of the meter at full tint requires to be amended roughly in accordance with the following factors:

Sky and clouds, give $\frac{1}{16}$ exposure found by meter for standard subject (C).

Sea, give $\frac{1}{8}$ exposure found by meter for standard subject.

Open distant landscape (A), give $\frac{1}{4}$ exposure found by meter for standard subject.

Light foreground (B), give $\frac{1}{2}$ exposure found by meter for standard subject.

Extra-dark foreground (D), give twice exposure found by meter for standard subject.

As regards subjects of this last type, D, one can, as already explained, actually test the light in the shadows and give an exposure corresponding with the time there noted, or somewhat less if thought necessary. The alternative course is to take the reading of the meter with the latter in the shadow of the body, and then give twice the time or more if the heaviness of the subject justifies it. One usually settles down to this latter method. It is a matter of choice. Some prefer to select a spot in the shadow for the meter test; others, to judge the subject and give twice or more the exposure.

A fair idea of the character of these subjects will be gathered from the reproductions marked in accordance with the letters used after each and bearing also the factor.

To this I would append one piece of advice, which the reader should write in big letters at the back of his mind.

With *open* subjects, A and B, err in the direction of *under* exposure.

With *heavy* foreground, D, err in the direction of *over*-exposure.

This advice holds good when working both with meters and calculators.

Exposure Calculators

The meter, as we have seen, does actually measure the light at the time of exposure. Tables or calculators of exposure go on a different system. They tabulate the actinic values of outdoor light throughout the year and throughout the day under the *assumed condition of a bright sunshine in a cloudless sky*, leaving us to judge how far the atmospheric conditions at the time of making our exposure are better or worse than the assumed conditions, for which the figures are given.

Light Variation

It would take us too far from the present subject to enter upon the basis of the daily and yearly variations in the power of sunlight. Suffice it to say that they can be calculated from the altitude of the sun in the sky (the result of the earth's daily rotation on its axis) and the "declination" of the sun, or the angle which the axis of the earth makes with the rays of light from the sun. Each day, as the sun climbs the heaven, the rays become more powerful, owing to the more direct path through our atmosphere which they take up to noon; *vice-versa*, from noon to evening. Assuming that the state of the sky remains the same, the light along latitude 40° (that passing through Philadelphia) will at early morning or late afternoon be about $\frac{1}{8}$ that at noon. The noon light of an unclouded sky on a given latitude varies with the seasons. Taking 1 as the value in summer (May-June-July), the power in spring and fall (March and April, August and September) is about $\frac{3}{4}$, and that in winter (November, December, January, February) about $\frac{1}{2}$. This is a rough approximation which shows that, so far as the motion of the earth is concerned, the variation in the power of the light in the year is from about 1 to 16.

Supposing that the figures obtained on this basis are correctly tabulated, the allowance that we still have to make for the variation of the light from sun to gloom represents probably a range of 1 to 5; so that, if we make a mistake between two successive degrees, we shall still not be far out. This range, of course, applies strictly to subjects where the light falls unobstructed. In subjects such as streets, buildings, avenues and woodlands, a further extra allowance must be made in

accordance with the indications of a subject table, aided by the worker's own judgment. It is with such badly lighted subjects as views under trees, interiors, that the meter excels the calculator; the latter in these circumstances is little more than a rough aid to guesswork.

All these things—hour of day, season, state of the sky, and situation of subject as regards access of light—are lumped together in the time which the meter paper takes to darken; in working by calculator we must take them one by one and make separate allowance. Nevertheless, calculators in conjunction with tables allow of this being very quickly done,—if anything, a little more quickly than taking a reading of the meter-paper.

Probably the most accurate tables of the value of daylight at different hours of the day and times of the year are those given by Mr. Gaston M. Alves in *THE PHOTO-MINIATURE* No. 54 (Now out of print.—Editor). They differ from most of their kind in splitting both the year and the day into a greater number of divisions, each corresponding with an equal change in the light intensity. Thus, they are more accurate (than the usual tables) for exposures early and late in the day. Like other tables, they give the intensity of direct sunlight (or rather the exposures with various diaphragms corresponding with such intensities and a given plate), and, as is the case with other tables, the numbers given require to be multiplied by a factor, depending on the state of the atmosphere, when photographing subjects on which the light falls unobstructed from the sky; and, still again by a factor, if the subject is further shielded from the light, e. g., is under trees, between tall buildings or inside buildings. In all such cases as this, a figure for the value of the outside light is a crude guide to the exposure, and though the photographer can be given some useful indication of the relatively much larger exposure which such subjects require, he is still left to rely very largely on his own judgment. In view of this fact, there is no doubt that a more approximate table than those of Mr. Alves may be taken. Most of these are based on the figures of Dr. Scott worked out for the Ilford Company, and used in conjunction with

TABLE (A) OF DAILY AND YEARLY VARIATION OF DAYLIGHT
ABOUT NORTH LATITUDE 40, NORTHERN UNITED STATES

A.M.	11	10	9	8	7	6	5
P.M.	1	2	3	4	5	6	7
May }							
June }	1	1	1	1½	2	3	4
July }							
March }							
April }							
August }	1	1½	2	3	6	..	..
September }							
February }							
October }	1½	2	3	6	..	..	..
January }							
November }	1½	2	4	..	..	..	..
December }							

TABLE (B) OF DAILY AND YEARLY VARIATIONS OF DAYLIGHT
ABOUT NORTH LATITUDE 30, SOUTHERN UNITED STATES

A.M.	11	10	9	8	7	6	5
P.M.	1	2	3	4	5	6	7
May }							
June }	1	1	1	1½	2	6	..
July }							
March }							
April }							
August }	1	1	1	2	3	..	..
September }							
February }							
October }	1	1	1½	2	6	..	..
January }							
November }	1½	1½	2	4	..	..	..
December }							

the circular calculator issued for Ilford plates. A further simplification of Dr. Scott's tables, applying to the northern and southern portions of the United States, is given below: The strongest light from 11 A.M. to 1 P. M. is denoted by the lowest number one, the weaker light earlier and later in the day by larger numbers which represent the increased degree of exposure required.

Weather Factors The choice of factors by which to allow for the condition of the atmosphere is one which goes largely by individual judgment, since one person forms a different idea from another as to what is meant by, say, "diffused light." But the following gives a fair idea of what must be carried in mind's eye:

- A. *Direct sun*, with white clouds in other parts of sky, reflecting light into shadows 1
- B. *Sun without clouds in sky* 1½
- C. *Diffused light*, sky covered with light clouds, leaving light bright enough to cast a distinct shadow . 2
- D. *Heavier clouds* over sky, no distinct shadows . . . 3

Thus, if the exposure is one second under condition A, it will be one and one-half seconds with the light as B, two seconds in "diffused light," and three seconds with "heavier clouds."

Subject Factors Further, it is necessary to allow for the shaded character of the subject, which is perhaps the factor which leaves most to the judgment. We have already given figures showing the proportional exposures required by "open landscape," etc. In using a calculator, we have no means of actually measuring the light, and therefore we must be guided by the following figures, which indicate the number of times an exposure on a "strong foreground" (Fig. 3) must be multiplied, other conditions remaining the same:

- Portraits, head and shoulders in shade × 4
- Woodlands, under trees × about 16
- Interiors light in color and well lighted × about 80
- Interiors dark × about 480 and upwards

More conveniently, reckon factor as eight and give

minutes instead of seconds,—that is, if “strong foreground” is found to require one-fourth second at $f/22$,—multiply $\frac{1}{4}$ by 8 ($= 2$) and give two *minutes* at this aperture.

Now there are two ways of putting this string of figures and factors into handy form. We may embody as many of them as we can into a table and multiply the expos-

Tables and
Calculators



Woodland subject, about sixteen times exposure of standard “strong foreground” subject, C

ures there set forth when other conditions so require; or we may set out the factors on a series of sliding scales, so as to dispense with the after-multiplication. The following table represents about the most compact form which the first plan can take. It leaves out of consideration the variation of light with the day and the year (tables A and B) and with the state of the atmosphere, as well as the greater exposure needed with slower plates. To allow for these, we shall need to multiply the exposures first by a figure in Table A or B,

EXPOSURES IN BRIGHTEST SUMMER SUNLIGHT (CLOUDS IN SKY REFLECTING LIGHT INTO THE SUBJECT)
ON ULTRA-RAPID PLATES OF SPEED, 250 WATKINS (III WYNNE)

At other times of day and other states of atmosphere, these figures must be multiplied by the necessary factors; also, by still a third factor when using slower plates

	Clouds	Sea	Open (distant) Landscape Subject A	Light fore- ground, land- scape, etc. Subject B	Strong fore- ground, land- scape, etc. Subject C	Extra heavy foreground Subject D	Under trees	Interiors, light in color and well lighted	Interiors dark
<i>f</i> /4	I-2000	I-1200	I-600	I-300	I-150	I-75	$\frac{1}{8}$	Min. $\frac{1}{2}$ Sec. $\frac{1}{2}$	Minutes $\frac{1}{2}$
<i>f</i> /5.6	I-1200	I-600	I-300	I-150	I-75	I-35	$\frac{1}{4}$	I	I
<i>f</i> /8	I-600	I-300	I-150	I-75	I-35	I-18	$\frac{1}{2}$	2	2
<i>f</i> /11	I-300	I-150	I-75	I-35	I-18	I-8	I	4	4
<i>f</i> /16	I-150	I-75	I-35	I-18	I-8	$\frac{1}{4}$	2	8	8
<i>f</i> /22	I-75	I-35	I-18	I-8	$\frac{1}{4}$	$\frac{1}{2}$	4	16	15
<i>f</i> /32	I-35	I-18	I-8	$\frac{1}{4}$	$\frac{1}{2}$	I	8	$\frac{1}{2}$	30
<i>f</i> /45	I-18	I-8	$\frac{1}{4}$	$\frac{1}{2}$	I	2	16	I	60
<i>f</i> /64	I-8	$\frac{1}{4}$	$\frac{1}{2}$	I	2	4	30	2	120

second by $1\frac{1}{2}$, 2 or 3, to allow for state of the weather, and third by a figure from $1\frac{1}{2}$ to 6, according to the speed of the (slower) plate.

In commercial calculators, various arrangements are used to relieve the photographer of the trouble of these simple sums in multiplication: but it should not be imagined that the indications of the exposures become any more accurate from the fact that the actual arithmetic process is in some measure disguised. It is unnecessary to deal at length with the different types of calculator on the market. They are easy enough to understand and use, and, with the qualifications which have been named, are most useful aids to correct exposure of outdoor subjects in bright summer lighting, though, as already mentioned, of much less value when the light is weak, early or late in the day, or when the subject is of a kind which is much shaded from the light. One of the most convenient calculators is that issued with the "Wellcome Exposure Record and Diary." It is used in conjunction with a series of tables of light values and of plate speeds, the data in the latter including practically every plate on the American and British markets. Other exposure calculators which are sold as separate instruments are the Wager Exposure scale, the Cheape Exposure meter, the Simplex Exposure meter (United States), and the Phillips and Biermann meters, in England, where also several plate-makers, in addition to the Ilford Co., issue calculators specially for use with their products. These include Wellington and Ward, the Imperial Company, and the Paget Prize Plate Company.

Making a Calculator

It might be thought that, with these various patterns in the market, there could be no object in making a calculator for one's own use; but for special purposes such a home-made calculator is more convenient than any which can be bought. It can be drawn up to go (if so desired) by the standard time, instead of the "mean time" of the place; it can provide exposures for the stops one's lens carries; and, further, it can be marked with the particular setting of a shutter necessary to give a given exposure,—a precaution which, as we shall see directly, is one not to be lost sight of. I will therefore describe

Light from Table A																		
									1	1½	2	3	4	6	8	12	16	24
Under trees.																		
U.S.	1	1½	2	3	4	6	8	12	16	25	32	48	64	100	128	196	256	
F. No	4	5	5.6	7	8	10	11	14	16	20	22	28	32	40	45	56	64	
200	150	100	75	50	35	25	18	12	8	6	4	3	2	1½	1	½	2	3
					Portraits heads in shade.		Extra heavy foreground		Strong foregrounds, full portraits.		Light foregrounds		open landscape		Sea		Clouds	

[illegible]

Diagram showing front of Home-made Calculator (page 414)

how to make a calculator which need not be much larger than a postal card, nor thicker than one or two stuck together. It consists of a sheath of card, from the front side of which two strips are cut, giving the apertures A and D. Within the sheath slides a card, bearing the figures relating to the light A, and the times of exposure D. The sliding card and the face of the sheath are ruled with lines about $\frac{1}{4}$ -inch apart. In placing the figures on these scales, the most convenient plan is to make each division $1\frac{1}{2}$ times that preceding it, or as near to this as can be done whilst using round numbers.

The first thing is to construct a table of light-values, to which (if we so wish it) the standard time of, say, Cincinnati, which is twenty-two minutes east of the ninetieth meridian, will apply. That is, the "mean" times of the tables must be reduced by twenty-two minutes to bring it back to "standard." For use with most tables this will not make much difference, but with the more accurate tables of Mr. Alves it is of advantage to employ it. However, in order to explain the construction of a calculator, we will take the more approximate table A already given for latitude 40° . This we shall paste on the back of the sheath, adding two others,—one for diffused light with double the numbers of table A doubled, and one for heavier clouds,—with the numbers three times those in table A, taking in each case the nearest whole number of those in line A of the calculator diagram, if the result of multiplication does not give it exactly.

On B we set off the figures for subjects, placing these one or more divisions apart, according to their requiring greater or less exposure than a strong foreground, remembering that a separation of one division means twice or half the exposure, according as subject is placed to left or right.

On the opposite edge of this part or the front sheath is placed a series C of diaphragm numbers, each again requiring one-and-one-half times the exposure of the preceding. This is conveniently marked in both American (U. S.) and *f*/ numbers.

Now we have to fill in the exposure scale D with numbers, each increasing by one-and-one-half. The

thing we have to do is start at such a point in the scale that the exposure opposite each $f/$ number shall be that to be given to a plate of given rapidity, choice must therefore be made of this latter. It is most convenient to assume a plate equal to the average ultra-rapid of 250 Watkins, or $f/111$ Wynne.

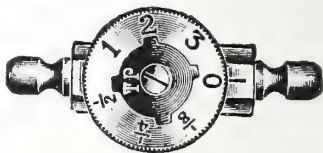
This is equivalent to about one-seventy-fifth of a second on a standard subject in best summer light with $f/5.6$ stop. That is, setting "strong foreground" to 1 from our table, we must place the series of exposures on scale D, so that one-seventy-fifth opposes $f/5.6$. The other exposures then follow as shown in the diagram.

Using the Calculator To use the calculator, look out the number in the tables on the back corresponding with the time of day and year and condition of atmosphere, and set this opposite the subject on scale B. On scale D, opposite the whole series of diaphragm will be seen the exposures for a plate of 250 Watkins, F III Wynne. If it is required to see the exposure on a faster or slower plate, the exposure for the stop to be used, say one-seventy-fifth second, is brought opposite the two heavy lines on scale E, when the exposure of a more rapid emulsion and for those of slower speed are seen opposite the respective figures, $\frac{1}{2}$, $1\frac{1}{2}$, 2, etc.

Giving Exposure Correctly Assuming, for the moment, that a study of the preceding pages has put the reader in the way to find out what is a reasonably correct exposure under given conditions, we must spare some lines for a few hints on how to ensure that the plate actually receives this discovered correct exposure. Exposures greater than, say, ten seconds, need not trouble us: they can be accurately timed with a watch. From ten seconds down to, say, two seconds, it is usual to time by counting, and various little dodges are in common use for aiding one to count seconds more correctly than one is likely to do simply by repeating One—Two—Three—etc., slowly. Every one has his pet formula for this purpose, of which one of the oldest is to count a b c d e f one, a b c d e f two, and so on, as rapidly as possible. This will give seconds so correctly that one is rarely a second out in using it to

count up to one minute. A similar kind of incantation is: One lit-tle second, two lit-tle seconds, three lit-tle seconds, and so on. From a time of one or two seconds down to one-fourth or one-eighth of a second is the most awkward period series of exposures to give correctly. Shutters, except those of the more expensive type, rarely give an exposure of less than one-tenth or one-fifteenth of a second; so that, in the absence of one which is correctly adjusted to give these slower exposures, the most convenient method is that of the "time-exposure valve," which is fitted to the pneumatic release of any shutter working to "bulb." The accessory in the best known form, viz., that made by the Thornton Pickard Company, is shown in the drawing.

It consists of a metal valve, the vent in which can be set more or less open by turning the disc. Air thus enters



more or less quickly after pressing the bulb, and so the shutter is closed after a shorter or longer interval, corresponding with the numbers on the graduated disc. In order that the valve shall work regularly, it is advisable to fit the bulb with a pair of metal pressure plates. These produce an even pressure each time, and avoid the uneven impulse which may be given to the bulb with the fingers.

Shutter Exposures

The greatest troubles commence when we come to the use of shutters giving exposures from one-tenth of a second and less, owing to the fact that the actual exposure given may not agree with the times (speeds) marked on the shutter; whilst shutters also differ in 'efficiency,' that is, in the degree to which they allow the full aperture of the lens to be in action during the whole period of exposure. The first source of error is, of course, the fault of the shutter-maker, who, however, cannot be expected to provide invariably correct speeds in the case of shutters the price of which is remarkably low. In diaphragm shutters the error is usually in two directions; the slowest speeds are not so slow as marked, whilst the highest

speeds are not so rapid as marked. Roller-blind shutters are less liable to be much at variance with the marked speeds, whilst focal-plane shutters are usually fairly correct to marking.

As regards efficiency, the focal-plane shutter, providing the slit does actually work close to the plate, say, within $\frac{1}{4}$ -inch, allows the full aperture of the lens to act during the whole time of the exposure. A roller-blind shutter, with an aperture in the blind long in comparison to the diameter of the lens (say ten times this latter), is not far short of the focal-plane. Both these shutters may be taken as giving exposures which are fairly comparable with time exposures given with a cap. That is to say, one-twentieth of a second at $f/5.6$ given with either of them will be truly equivalent to the three seconds which represents the corresponding correct exposure at $f/45$. That will not be the case with some shutters, the efficiency of which is only one half, necessitating, in the above instance, one-tenth of a second at $f/5.6$ to obtain the same degree of exposure as three seconds at $f/45$.

It would take us too far from our
The Moral present subject to go further into the question, but I can put the practical moral into a few words: In finding, as directed in an earlier paragraph, the speed number of the plate, make the exposure by the means which you will most usually employ in practice. If your work chiefly runs to time exposures, let the test be in this way, selecting a stop which will allow of your giving at least five seconds. If the exposures are to be chiefly instantaneous, use the shutter at the speed and with the lens which you will regularly employ. In this way you make an allowance for any departure of the shutter from correctness. Better, of course, if you can get the actual speed of your shutter measured, and in accordance therewith inscribe your meter or calculator to the effect; for example, that for a true one-thirtieth second, you must use your shutter at "one-fiftieth second." Fortunately for the great majority of ordinary hand-cameras,—that is, apart from exposures on very rapidly moving objects,—it is rarely necessary to use a shorter exposure than one-fiftieth sec-

ond; so that my first advice to allow for the shutter in the plate-speed is really a practical one, dreadfully unscientific though it is.

Diaphragm Shutters I add a further note on these shutters because what has already been written may unjustifiably prejudice the reader against them. It is true that there are more examples of variation in this class of shutter than any other, but a number of excellent patterns are on the market, such as the Bausch and Lomb "Volute," the "Compound" and "Koilos," the "Ibso," and the remarkable "Multi-speed." This latter, owing to the special pivotal construction of the plates which cover and uncover the aperture, greatly reduces the periods of opening and closing, and so allows the full lens to act during a very large proportion of the total time (= high efficiency). In the case of shutters of the ordinary patterns, a very good plan is to use one a size larger than the lens, e. g., a 5 x 7 shutter on a 4 x 5 or quarter plate. One thus utilizes the period of the shutter's movement when the aperture is fully uncovered, and so gets higher efficiency.

Ortho-Screen Exposures Of late years, improvements in both orthochromatic plates and light filters have opened up a new power in hand-camera photography,—that of the use of a screened iso plate for snap-shot work; it will therefore be useful to include a mention of the limits within which work of this kind can be done with reasonable expectation of satisfactory results. Then recent advances have been in the production of high-speed color-sensitive plates, such as the Eastman "Isochromatic," the Cramer "Instantaneous Iso," the Seed "Ortho L" and "Ortho C," which we may roughly class together as regards speed at about 200 Watkins. A still more rapid plate, the Barnet "Super Speed Ortho," recently placed on the British and American markets with a speed of over 300 Watkins, seems to foreshadow still further introductions of orthochromatic plates of extreme speed. Hand in hand with this progress in emulsions, makers of light-filters, Cramer and Wratten & Wainwright in particular, have produced screens which, owing to their greater transparency, give the same amount of correction with a less

increase in exposure compared with the now obsolete filters of colored glass. We may now take it that a filter giving a requisite amount of correction will not need more than three or four times the exposure without it in the case of these ortho plates, and in many instances that a filter of multiplying factor of two will suffice. This being so, it will be seen that, with a lens at $f/6$ in bright summer light, exposures of one-twentieth to one thirtieth second are quite practicable, and that still shorter times may be given with a large-aperture anastigmat of $f/4.5$ = a facility for the use of which is provided by a reflex camera. Quite recently in the winter light of London, England, the writer made a series of snapshot exposures through a filter on one of the new rapid iso plates, which shewed the great powers afforded in this way.

Exposures on Moving Objects When we come to work out the exposure which we must give in the case of objects which are in motion, we have to go on a totally different system. We have not to expose *long enough* to get a proper rendering of the light and shade, but *short enough* to prevent the object forming a blurred image in the photograph, in consequence of the image moving on the plate during the time the lens remains uncovered. In short, as a general rule, exposure which is correct as regards getting a moving object sharp on the plate is a different thing from an exposure which gives a correct rendering of the light and shade in the same subject. Usually it is a good deal less; and one may take it that, whenever we are exposing rapidly enough to secure sharp images of objects in rapid motion, we may look forward to under-exposure in the ordinary sense of the word. I might elaborate a theory of the time which must not be exceeded in photographing moving objects at various distances and with lenses of different focal lengths. The basis of such a theory is that the image of the moving object must not move more than one-one-hundredth of an inch on the plate during the exposure; better not more than one-two-hundredth of an inch if a high degree of sharpness is desired. But I will leave my readers with a liking for calculations to work the stages of the process out for themselves, which they can readily do from the simple laws of the forma-

tion of an image by a lens or by reference to THE PHOTO-MINIATURE No. 77. Here we must get straight to a guide which we can adopt in practical work. As a most useful basis, we will take that of a lens of five inches focal length, supposing the object to be twenty-five feet away, or approximately the width of a roadway in which not more than three vehicles can pass each other readily. This condition means that a man of six feet will appear on the plate one inch in height, and similarly other objects will be reproduced about one-seventieth their actual size. Keeping these fairly average conditions in mind, we must further learn that it is the *direction* in which an object is moving with regard to the camera which very greatly decides the speed of shutter which is necessary or permissible. If the subject is advancing directly towards the camera,—that is, more or less along the axis of the lens,—the movement is far less apparent than if he is crossing the field of view at right angles. Roughly it may be said that, in the case of the “end on” movement, the exposure can be three times that which is necessary to secure sharpness when the subject is going across the field of view. If the movement is obliquely toward us,—or, what is the same thing, if the camera is directed obliquely to the path along which the object is moving,—the exposure may be about twice that necessary for the “cross” movement. To take a concrete case of a carriage moving, say, at eight miles per hour, the exposure will be about as follows: End on, one-eightieth second; oblique, one-one-hundred-fiftieth second; cross, one-two-hundred-fiftieth second.

This is a rough guide to the effect of direction. As a rule, the high speeds which are necessary to secure sharpness of objects moving across the field make it impossible to deal successfully with anything but a walking pace under these conditions,—that is, with the majority of shutters which do not go above one-two-hundredth of a second.

The further the object or the shorter the focal length of the lens, the smaller the image, and the longer we can expose without sacrificing sharpness. Thus, if the object is fifty feet instead of twenty-five feet away, we can give double; if one-hundred feet away, four times

the exposure. A useful table of speeds for a variety of moving objects under the above standard conditions is given in the "Wellcome Exposure Record." We may give here one or two, which perhaps represent the generality of work:

Subject	End on	Oblique	Acro-s
	Second	Second	Second
People walking	1-40	1-80	1-120
Carriages driving	1-100	1-200	1-300
Running, jumping, skipping . .	1-250	1-500	1-800
Cycle racing, etc.	1-300	1-600	1-1000
Train 30 miles per hour, 50 feet away	1-200	1-400	1-600
Train 60 miles per hour, 50 feet away	1-400	1-800	1-1200

One thing that cannot be allowed for in a table of this kind is the fact that, though an object may not be moving very rapidly as a whole, yet parts of it, the legs of a horse or the spokes of a wheel, are very likely moving at double this speed. A little blur of this kind is less objectionable than in the other parts, since to show subjects of this kind dead sharp everywhere is rather to kill any suggestion of movement.

Exposures from Trains, Cars and Boats Exposures from moving vehicles follow just the same rules as those named in the preceding paragraph as regards direction: we must shorten exposures when we point the camera at right angles to the direction we are traveling in, but can give longer when the lens is directed forward or back at an angle, say, thirty degrees, which is quite possible from a train, whilst from a steamer or electric car we can photograph directly in front or behind. In the case of a train moving from forty to sixty miles per hour, it is not possible to count on securing subjects other than open views, such as bays, estuaries, or open country, and for these an exposure of from one-fortieth to one-sixtieth second will be quite short enough. In the case of steamers, the vibration from the motion of the ship

is generally greater; but, as the subjects will do with very short exposures, it is the easiest vehicle from which to photograph. The best position is by the paddle-boxes, where vibration is less than either forward or aft. The greatest difficulties surround the use of the camera from the top of an omnibus or electric car. The horse 'bus and, still more, the motor 'bus, usually vibrates to such an extent that the exposure requires to be much shorter than would be judged from its speed only. About one-two-hundredth of a second may be taken as a guide, and the photographer must stand when releasing the shutter, otherwise he gets all the benefit of the vibration.

When Speed is a Drawback There are one or two subjects of rapid movement where the results obtained by driving the shutter at too high a speed are the reverse of advantageous. Breaking waves, fountains and cascades are examples. With a very rapid exposure, say one-three-hundredth of a second, the drops and splashes of water are so biting defined that a "frozen" effect is obtained and is quite unnatural and unpleasant. It is necessary to give a longer time, which will allow these separate drops to fuse together in the photograph and give the effect which we do really see. If too long time is given, the "smoothed-out" result is just as objectionable in the other direction. A fair guide to these exposures is one-eightieth to one-hundred-and-fiftieth of a second, which is equivalent to about the top speed of a roller-blind and a good diaphragm shutter, respectively. For wave pictures in bright summer light with an extra-rapid plate, this will mean a stop of $f/16$ to $f/11$.

Cutting Down Exposure It is surely unnecessary to tell the reader of the foregoing paragraphs that, in the case of moving objects, we must often—in fact, usually—curtail the exposure much below that which we know to be necessary for the plate, in order to avoid movement in our rendering of the subject. In other words it is "not what we *would*, but what we *must*," if we wish to obtain a record unmarred by blurring. Therefore it is useful to obtain some idea of the degree to which we can cut down the expo-

sure which our plate calls for, in order to satisfy the demands (purely optical) made by the moving subject. The latitude which is permissible in this direction depends solely upon the plate, and upon a specific quality of the plate of rendering faint impressions of light. So that what will hold good with one plate will break down altogether with another. A rough sort of guide is provided by saying that for snap-shot work, where sharpness of definition of the moving objects is more important than the best rendering of the tones in the subject, one-half the "correct exposure" as found by the meter or calculator may be given. That means that we can take the speed of the plate as double the figure, usually adopted. As we have learned already the plate-speed is a convenient means of adjusting conditions. Here, by taking a plate as $f, 128$ Wynne instead of $f, 90$, or 350 Watkins instead of 180 , we can work straight along by the exposure tables and be fairly sure that, though we shall not be giving what are really full exposures, we shall nevertheless be getting reasonably good negatives. If these exposures are still too long, we can go a trifle further in this course of "frigid and calculated" under-exposure, as Mr Balfour might call it, say, to an extent represented by a plate-speed one-third of that adopted in the ordinary full-exposure way; that is to say, we might reckon out plate (just assumed to be 90 Wynne or 180 Watkins) as 156 Wynne or 500 Watkins.

In any case, the two simple factors, one-half and one-third, of the correct exposure are easily borne in mind, though, with them, please, the fact that some plates will come through this ordeal of cutting down exposure much more satisfactorily than others. The slower a plate is, as a rule, the better it will behave when it does not get its full exposure; but, even among extra-rapid plates, there are very notable differences, quite enough to even-up any supposed excess of speed.

For exposures by moonlight or by street lighting at night, it is impossible to lay down very definite rules, as the illumination varies so enormously, but one or two *very* rough figures may be given as a guide.

With the moon at the full and a lens at $f/6$, the exposure for a landscape subject by moonlight will be from ten to thirty minutes on a plate of 200 to 250 Watkins. This will give a moonlight effect of dark shadows and somewhat harsh lighting. By exposing for very much longer time, the effect of ordinary daylight is obtained. In either case, the subject must be arranged on the plate so that the moon's disk is not included, otherwise the result is a band of light due to the movement of the planet. The moon can be included on the same plate by a separate exposure, after tilting the camera, for about one-fourth second. The pseudo-moonlight effects made by turning the lens toward the sun in strong daylight are obtained by giving great under-exposure—one-tenth to one-twentieth of a second—at $f/22$ on a "medium-speed" plate, which should be backed.

For street scenes by night under arc or powerful gas lighting, the most favourable conditions are with snow or heavy rain on the ground. With $f/6$ on plates of about 200 Watkins exposure will be from five to ten minutes: twice this, or more, if very dark objects are in the neighborhood of the camera.

If the subject is all quite near to the camera and brightly illuminated, exposures will range from about one to five minutes.

**Copying and
Enlarging in
the Camera**

The rule that exposures must be proportional to the focal extension of the lens is very conveniently applied by the following method and tables, due, I think, to Mr. Alfred Watkins, to whom we owe numberless useful suggestions for simplifying exposure calculations. It is to use a small rod equal in length to the focus of the lens and divided into tenths.—Better still, is a tape marked in focal-lengths, and one-tenth focal-lengths. See how many times the focal length goes into the distance between the lens-diaphragm and the original which is being copied, and look up the nearest figure in Table 1. The figure immediately underneath in line B give the scale of reduction, (linear); those in lines C and D the relative exposure compared with those for a similar subject, with the lens at normal focus (on infinity) and when at double extension for copying same

size. When copying direct on an enlarged scale, a similar device is used to measure the distance between lens-diaphragm and plate in focal lengths. Look up this number in Table II, line A. The figure immediately underneath in line B gives the degree of enlargement; that in line C, the relative exposure compared with the lens at normal extension; and that in line D, exposure compared with the lens at double (same size) extension.

TABLE I—RELATIVE EXPOSURE WHEN COPYING ON
A REDUCED SCALE

A —Times focal length of lens divides into distance between lens and easel.	11	9	7	5	3	$2\frac{4}{5}$	$2\frac{3}{5}$	$2\frac{2}{5}$	$2\frac{1}{5}$	2
B —Proportion of image to original, i. e. degree of linear reduction.	$\frac{1}{10}$	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{5}{9}$	$\frac{5}{8}$	$\frac{5}{7}$	$\frac{5}{6}$	1
C —Relative exposure compared with lens at normal extension.	$1\frac{1}{5}$	$1\frac{1}{4}$	$1\frac{1}{3}$	$1\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{2}{5}$	$2\frac{3}{5}$	$2\frac{9}{10}$	$3\frac{2}{5}$	4
D —Rel'. exp'. compared with that when copying same size.	$\frac{1}{3}$ (.3)	$\frac{1}{3}$ (.31)	$\frac{1}{3}$ (.34)	$\frac{2}{5}$ (.39)	$\frac{1}{2}$ (.56)	$\frac{3}{5}$ (.60)	$\frac{4}{5}$ (.66)	$\frac{7}{10}$ (.73)	$\frac{8}{10}$ (.83)	1

TABLE II—RELATIVE EXPOSURES WHEN COPYING ON
AN ENLARGED SCALE

A	2	$2\frac{1}{5}$	$2\frac{2}{5}$	$2\frac{3}{5}$	3	$3\frac{1}{5}$	4	$4\frac{1}{2}$	5	6	7	8	9	10	11
B	1	$1\frac{1}{5}$	$1\frac{2}{5}$	$1\frac{3}{5}$	2	$2\frac{1}{5}$	3	$3\frac{1}{2}$	4	5	6	7	8	9	10
C	4	$4\frac{4}{5}$	$5\frac{3}{4}$	$6\frac{3}{4}$	9	$12\frac{1}{4}$	16	20	25	36	49	64	81	100	121
D	1	$1\frac{1}{5}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$2\frac{1}{4}$	3	4	5	$6\frac{1}{4}$	9	12	16	20	25	30

BOOKS

The Watkins Manual of Exposure and Development. By Alfred Watkins. Price, 50 cents.

Watkins Exposure Notes and Record for use with Watkins Meters. Price, 50 cents.

The Photo-Miniature, No. 77; Focal Plane Photography. Price, 25 cents.

The Wellcome Photographic Exposure Record & Dairy. Price, 50 cents.

Notes and Comment

Numbers 2, 11, 16, 32, 38, and 75 of **THE PHOTO-MINIATURE** are wanted by several subscribers, anxious to complete their files of the magazine. Readers who have copies of these issues, and are willing to part with them at fifty cents apiece, will confer a favor by advising our publishers to that effect. By considerable effort, we have managed to get together three complete sets of **THE PHOTO-MINIATURE** (Vols. I to VIII inclusive; Nos. 1 to 96). These are offered at \$25 per set, delivered prepaid. Libraries and others desirous of securing a set of the magazine should make early application, as it is becoming increasingly difficult to get complete sets together, more than 40 of the 105 numbers published being now out-of-print and permanently retired from the series.



Enlargements on chloride papers (Velox, Cyko, Argo and Artura), giving all the advantages of these papers over bromide and offering the wonderful range in grades, surfaces, etc., of the chloride papers, are now obtainable commercially. These enlargements have all the sparkle, shadow detail and tone gradations of an original print. Those interested should write for the circular of information to H. W. Von Bremen, 27 East 22nd street, New York.



The Voigtlander & Sohn Optical Works, 225 Fifth Avenue, New York, have established a Western branch as 617-631 West Jackson Boulevard, Chicago, for the convenience of the trade and customers west of the Ohio River. The Chicago branch house, like the New York branch, will carry a full line of the Voigtlander lenses, cameras, binoculars and other optical specialties.

The three big exposure helps available for American readers of these pages are the "Wellcome Exposure Record and Diary," published by Burroughs, Wellcome & Co., 45 Lafayette street, New York; the Watkins Exposure Meters (several styles for different purposes), for which Burke & James, Chicago, are American agents; and the Wynne Infallible Exposure Meters, for which George Murphy Inc., New York, are Trade agents. All three can be obtained from any dealer in photographic supplies.

The most interesting collection of photographs of big game we have yet seen is contained in A. Radclyffe Dugmore's "Camera Adventures in the African Wilds," just published by Doubleday, Page & Co., New York, and William Heinemann, London. The illustrations are beautifully printed and the text is as thrilling a record of personal adventure as can be desired.

Now that the Antinous Shutter Release is obtainable for all makes and styles of exposure shutters in the market, the days of the fragile and pestiferous rubber bulb and tube should be numbered. We have used the Antinous Release since its first appearance, and cannot praise it too highly for its simplicity, convenience and infallible certainty of operation. It is manufactured by William Watson & Sons, London, and can be had from any dealer. Burke & James, of Chicago, and George Murphy Inc., of New York, are the American Trade Agents.

No 8 of the Telephoto Quarterly, recently issued, completes the second volume of this clever little magazine, which is the only periodical devoted exclusively to the possibilities and practical use of the telephotographic lens. Edited by an authority in this specialty, Captain Owen Wheeler, F.R.P.S., and fairly bristling with practical information and interesting illustrations, "T.-Q." is an eye-opener to the man who is not fully up-to

date in his knowledge of what can be done with a telephoto lens. Single copies 25 cents; yearly subscription 75 cents. Tennant and Ward, New York.



An exhibition of color photographs by Eduard J. Steichen was given at the Little Gallery of the Photo-Secession, 291 Fifth Avenue, New York, January 21 to February 5th. The show comprised many examples of Steichen's latest work in color, and was more largely attended than any recent exhibition at the little Gallery. About the same time, an exhibition of Steichen's paintings, with 25 photographs, was given at the old Montross Gallery, 372 Fifth Avenue. Among the photographs were three views of Rodin's famous Balzac, from negatives made at 11 P.M. and 4 A.M.



The New England branch of Ansco Company has been removed to 46 Cornhill, Boston, Mass., where increased space makes it possible to carry a larger stock of Cyko and other Ansco goods, thus insuring a better service to the thousands of Cyko consumers throughout New England.



Hand-colored post-cards of local scenes are among the most attractive and profitable side lines the photographer, druggist or stationer can carry. In this line of work the National Colortype Co., Cincinnati, are acknowledged leaders, and readers are recommended to send their orders to this house as offering a good service at reasonable cost.



The publishers of our enterprising contemporary, "American Photography," Beacon Bldg., Boston, Mass., have secured the entire second edition (5,000 sets) of the "Complete Self-instructing Library of Practical Photography," and offer it to subscribers to "American Photography" at the net wholesale price. This is an unusual opportunity to secure this splendid library of photo-

38



39



40



41



PLATE XI. Figs. 38, 39, 40, 41. Read left to right



PLATE X. Fig. 37. Portrait.—Chardin

graphic information, and our readers will consult their own advantage by sending for the illustrated prospectus of the work.



The latest issue of "Portrait," published by the Ansco Company, Binghamton, New York, gives a portrait of our friend Charles C. Kough, of Greensburg, Pa. For years we have watched the professional career of Mr. Kough with more than ordinary interest. A man who loves his work and gives all his heart to its improvement, Mr. Kough has few equals in the difficult work of illuminating (or lighting) the figure in portraiture. His portraits of women have the qualities of plasticity, soft relief and brilliancy in a degree which we rarely find in professional portraiture, and we commend the study of his work to all who seek to excel in this specialty.



Those who are interested in the possibilities of photography in the illustration of advertising matter should not fail to see the January number of "Studio Light," published by the Eastman Kodak Co., Rochester, N. Y. In this issue are given the prize-winning pictures from the recent Advertising Contest, from negatives by William Shewell Ellis, Gertrude Kasebier, Bruguier & Eisen, S. H. Liphey, and others of equal note.



A remarkable plate, according to the testimony of experts who have used it, is the new Barnet Super-Speed Ortho Plate (400 H&D), introduced in America by J. L. Lewis, 379 Sixth Avenue, New York. With this plate and a two-times ortho screen, snap-shot work in dull or wet weather and difficult flashlight work is not only possible, but as certain in result as it is simple, with the great advantage of correct color rendering.



The fifth edition of "Figures, Facts, and Formulæ of Photography," published as "The Photographic Annual," is almost completely sold out, only a few copies

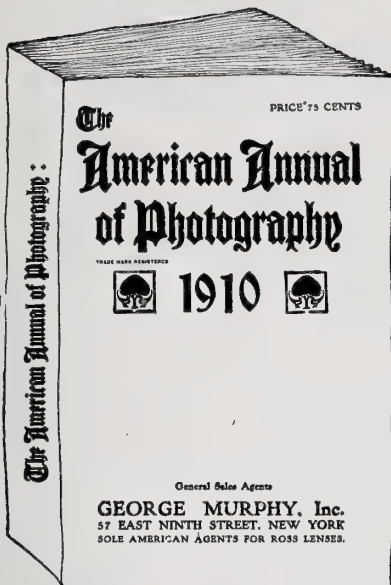
remaining in the hands of the publishers or the trade. As many would-be purchasers of the last edition had to go without this wonderful photographic reference book, because they delayed until the edition was exhausted, readers who desire copies of the 1909 edition should secure them at once. Sold by all dealers, price 50 cents. Tennant and Ward, publishers.



The Fifth International Congress of Photography is to be held this year at Brussels, probably during the month of July. The last Congress was held at Liège, in 1905. The subscription fee of membership is ten francs. Applications, with remittances, should be sent to M. L. P. Clerk, 52 Boulevard Saint Jacques, Paris. Members receive a printed copy of the proceedings of the Congress, together with the papers read there, which is the chief advantage of membership to those who cannot attend the Congress in person.



The Linked Ring has decided not to hold a Salon in London this year. A few of the members propose to hold exhibitions of two or three men's work in some of the galleries, probably in the Spring. A Salon Club has been formed to hold the London Salon of 1910. This club includes J. H. Anderson, A. H. Blake, M. A., Mr. and Mrs. Will A. Cadby, Riginald W. Craigie, Chas. Emanuel, Chas. Job, Alexander Keighley, and J. B. B. Wellington, from amongst the members of the Linked Ring, while others have promised work for its exhibitions. Certain pictorialists, who are not members of the Ring, have joined the Salon Club, and it is assured of the active sympathy of Yarnall Abbott, Sidney Carter, Robert Demachy, Rudolph Duhrkoop, the brothers Hofmeister, Mortimer-Lamb, Paul Pichier, C. Puyo, and many others. Its effort will be to hold the most Catholic and inclusive exhibitions ever assembled of purely pictorial photography.



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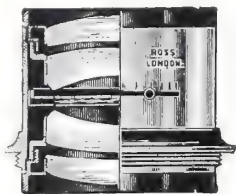
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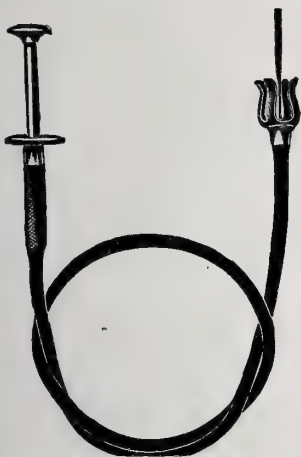
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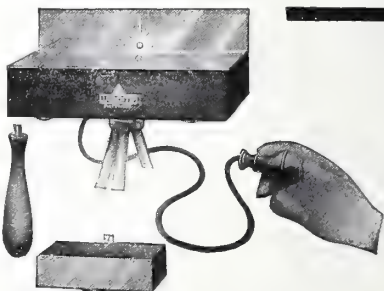
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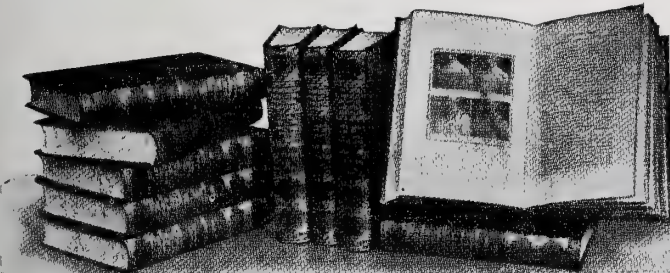
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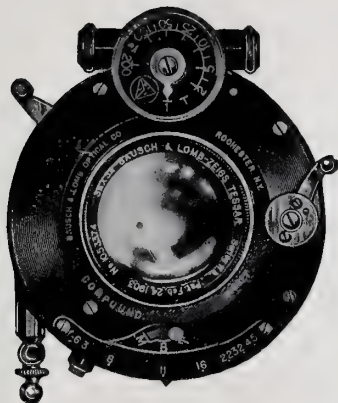
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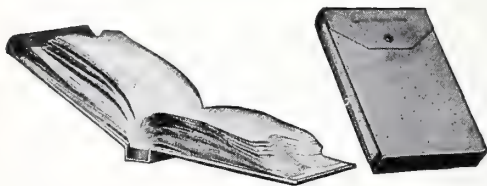
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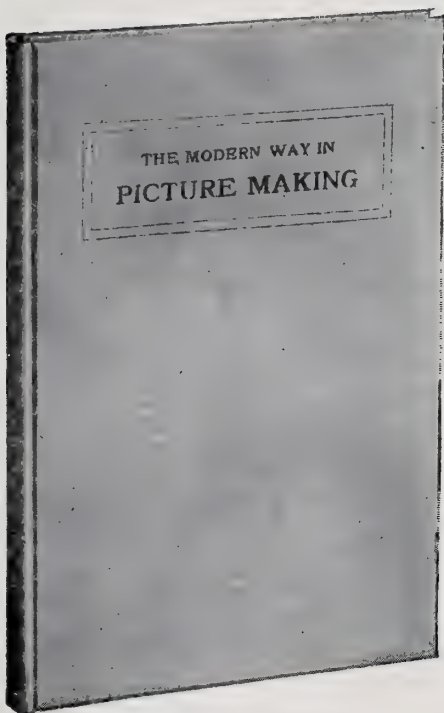
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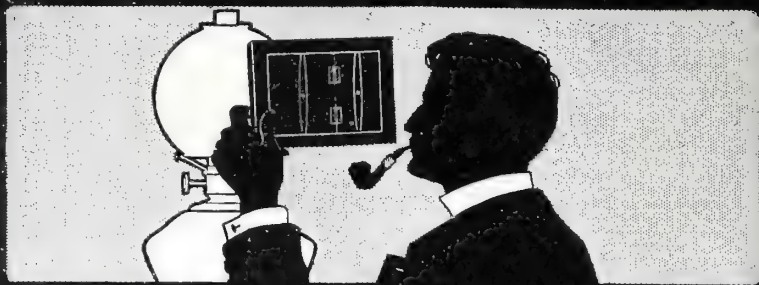
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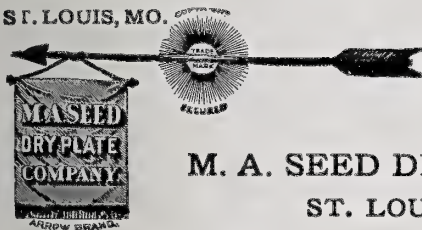
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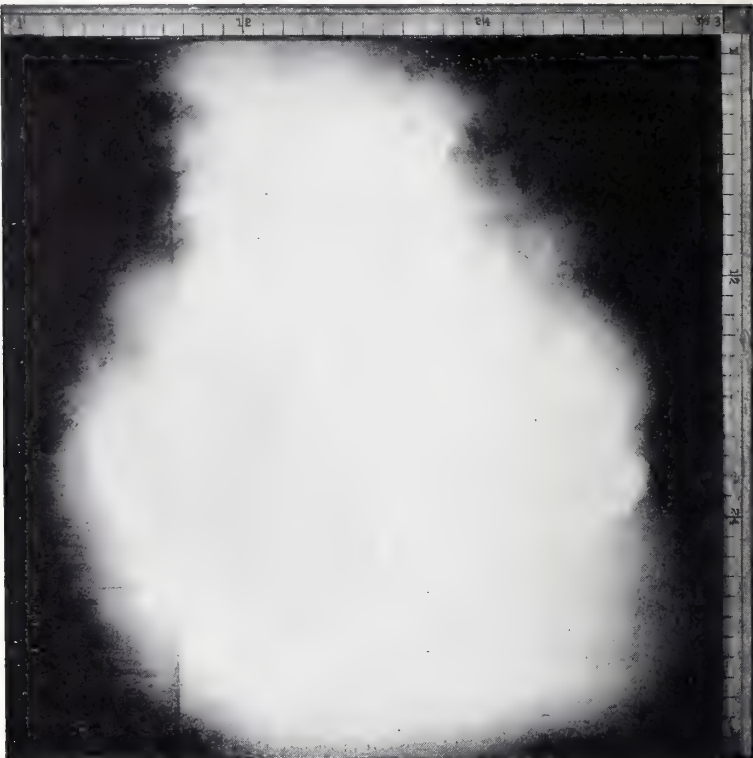
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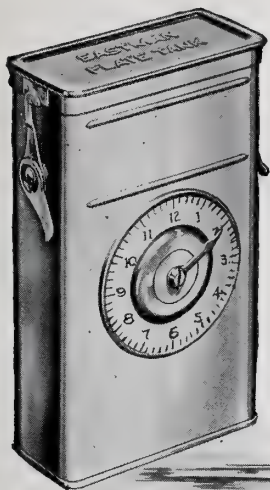
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